09/892,500
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<u>IN THE SPECIFICATION:</u>

Please amend the specification, as follows:

<u>On pages 4-11, revise the consecutive paragraphs beginning at line 7 on page 4 through the paragraph ending at line 15 on page 11, as follows:</u>

In order to achieve the above-described objects, an arrayed waveguide grating of the ~~invention as described in claim 1~~ <u>invention, as described in a first aspect,</u> comprises (a) a substrate; (b) a first channel waveguide disposed on the substrate; (c) a channel waveguide array disposed on the substrate and constituted in such that each length of waveguides is sequentially longer with a predetermined difference in lengths of the waveguides; (d) a first slab waveguide disposed on the substrate and connecting the first channel waveguide with said channel waveguide array; (e) a second slab waveguide disposed on the substrate and connecting an end of the channel waveguide array on the side wherein the first slab waveguide has not been connected thereto with an end thereof; and (f) a second channel waveguide disposed on the substrate and connected to the other end of the second slab waveguide wherein a waveguide part in the connected area has a parabolic configuration.

Namely, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the arrayed waveguide grating into a parabolic configuration in the ~~invention as~~ <u>invention, as</u> described in ~~claim 1~~ <u>in the first aspect</u>.

An arrayed waveguide grating of the ~~invention as~~ <u>invention, as</u> described in ~~claim 2~~ <u>a second aspect,</u> comprises (a) a substrate; (b) a first channel waveguide disposed on the substrate; (c) a channel waveguide array disposed on the substrate and constituted in such that each length of waveguides is sequentially longer with a predetermined difference in lengths of the

waveguides; (d) a first slab waveguide disposed on the substrate and connecting the first channel waveguide with the channel waveguide array; (e) a second slab waveguide disposed on the substrate and connecting an end of the channel waveguide array on the side wherein the first slab waveguide has not been connected thereto with an end thereof; and (f) a second channel waveguide disposed on the substrate and connected to the other end of the second slab waveguide wherein a waveguide part in the connected area has a configuration as a multi-mode interference in which a width of optical waveguide changes step-functionally and discontinuously.

Namely, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the arrayed waveguide grating into a configuration of multi-mode interference in which a width of optical waveguide changes step-functionally and discontinuously in the ~~invention as~~ invention, as described in ~~claim 2~~ the second aspect.

An arrayed waveguide grating of the ~~invention as~~ invention, as described in ~~claim 3~~ a third aspect, comprises (a) a substrate; (b) a first channel waveguide disposed on the substrate; (c) a channel waveguide array disposed on the substrate and constituted in such that each length of waveguides is sequentially longer with a predetermined difference in lengths of the waveguides; (d) a first slab waveguide disposed on the substrate and connecting the first channel waveguide with the channel waveguide array; (e) a second slab waveguide disposed on the substrate and connecting an end of the channel waveguide array on the side wherein the first slab waveguide has not been connected thereto with an end thereof; and (f) a second channel waveguide disposed on the substrate and connected to the other end of the second

slab waveguide wherein a waveguide part in the connected area has a rectangular field distribution exciting configuration that excites a rectangular field distribution.

Namely, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the arrayed waveguide grating into a rectangular field distribution exciting configuration that excites a rectangular field distribution in the ~~invention as~~ invention, as described in ~~claim 3~~ the third aspect.

The ~~invention as~~ invention, as described in ~~claim 4~~ a fourth aspect, is characterized in that the parabolic configuration is individually adjusted in response to respective wavelengths of multiplexed optical signals input to the first channel waveguide in the arrayed waveguide grating as ~~claimed in claim 1~~ described in the first aspect.

Namely, broadening of band in wavelength used in the arrayed waveguide grating is realized by adjusting individually the parabolic configuration in response to respective wavelengths of multiplexed optical signals input to the first channel waveguide in the ~~invention~~ invention, as described in ~~claim 4~~ the fourth aspect.

The ~~invention~~ invention, as described in ~~claim 5~~ a fifth aspect, is characterized in that the configuration as a multi-mode interference is individually adjusted in response to respective wavelengths of multiplexed optical signals input to the first channel waveguide in the arrayed waveguide grating as ~~claimed in claim 2~~ described in the second aspect.

Namely, broadening of band in wavelength used in the arrayed waveguide grating is realized by adjusting individually the configuration as a multi-mode interference in response to respective wavelengths of multiplexed optical signals input to the first channel waveguide in the ~~invention~~ invention, as described in ~~claim 5~~ the fifth aspect.

The invention as described in ~~claim 6~~ a sixth aspect is characterized in that the rectangular field distribution exciting configuration is individually adjusted in response to respective wavelengths of multiplexed optical signals input to the first channel waveguide in the arrayed waveguide grating as ~~claimed in claim 3~~ described in the third aspect.

Namely, broadening of band in wavelength used in the arrayed waveguide grating is realized by adjusting individually the rectangular field distribution exciting configuration in response to respective wavelengths of multiplexed optical signals input to the first channel waveguide in the ~~invention~~ invention, as described in ~~claim 6~~ the sixth aspect.

The invention as described in ~~claim 7~~ a seventh aspect is characterized in that the rectangular field distribution exciting configuration is such a configuration that an angle θw defined by a boundary part of an outputting channel waveguide in a starting point from which a width of waveguide changes and a central axis of the waveguide has a value larger than zero degree and smaller than ninety degrees, and tapered configurations are excluded from these resulting configurations in the arrayed waveguide grating as ~~claimed in claim 3~~ described in the third aspect.

Namely, it is to be made clear that the rectangular field distribution exciting configuration is such a configuration that an angle θw defined by a boundary part of an outputting channel waveguide in a starting point from which a width of waveguide changes and a central axis of the waveguide has a value larger than zero degree and smaller than ninety degrees, and tapered configurations, which do not function, are excluded from these resulting configurations in the ~~invention~~ invention, as described in ~~claim 7~~ the seventh aspect.

An optical communication system of the ~~invention~~ invention, as described in ~~claim 8~~ an eighth aspect, comprises (a) an optical transmission means for delivering optical signals having

respective wavelengths in parallel; (b) a multiplexer composed of arrayed waveguide gratings for subjecting the optical signals having the respective wavelengths delivered from the optical transmission means to wavelength division multiplexing; (c) an optical transmission line for transmitting the optical signals which have been wavelength division-multiplexed and output from the multiplexer; (d) nodes each provided with an arrayed waveguide grating disposed properly in the middle of the optical transmission line; (e) a demultiplexer composed of an arrayed waveguide gratings to which optical signals delivered through the nodes disposed on the optical transmission line are input to separate into each of optical signals having respective wavelengths; and (f) an optical receiver for receiving optical signals having the respective wavelengths separated by the demultiplexer; (g) each of the arrayed waveguide gratings being composed of a substrate; a first channel waveguide disposed on the substrate; a channel waveguide array disposed on the substrate and constituted in such that each length of waveguides is sequentially longer with a predetermined difference in lengths of the waveguides; a first slab waveguide disposed on the substrate and connecting the first channel waveguide with the channel waveguide array; a second slab waveguide disposed on the substrate and connecting an end of the channel waveguide array on the side wherein the first slab waveguide has not been connected thereto with an end thereof; and a second channel waveguide disposed on the substrate and connected to the other end of the second slab waveguide wherein a waveguide part in the connected area has a rectangular field distribution exciting configuration that excites a rectangular field distribution.

Namely, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the respective arrayed waveguide gratings constituting a line-like communication system into a

rectangular field distribution exciting configuration that excites a rectangular field distribution in the ~~invention~~ invention, as described in ~~claim 8~~ the eighth aspect, wherein the above-described line-like communication system is composed of an optical transmission means for delivering optical signals having respective wavelengths in parallel; a multiplexer composed of arrayed waveguide gratings for subjecting the optical signals having the respective wavelengths delivered from the optical transmission means to wavelength division multiplexing; an optical transmission line for transmitting the optical signals which have been wavelength division-multiplexed and output from the multiplexer; nodes each provided with an arrayed waveguide grating disposed properly in the middle of the optical transmission line; a demultiplexer composed of an arrayed waveguide gratings to which optical signals delivered through the nodes disposed on the optical transmission line are input to separate into each of optical signals having respective wavelengths; and an optical receiver for receiving optical signals having the respective wavelengths separated by the demultiplexer.

An optical communication system of the ~~invention~~ invention, as described in ~~claim 9~~ a ninth aspect, comprises (a) an arrayed waveguide grating having a circular transmission line prepared by connecting circularly a plurality of nodes by the use of transmission lines and transmitting optical signals which have been wavelength division-multiplexed to these transmission lines, and separating the wavelength division-multiplexed optical signals into optical signals having respective wavelengths; and an arrayed waveguide grating for wavelength division-multiplexing optical signals, which have been separated into those having respective wavelengths; (b) each of these respective arrayed waveguide gratings being composed of a substrate; a first channel waveguide disposed on the substrate; a channel waveguide array disposed on the substrate and constituted in such that each length of

waveguides is sequentially longer with a predetermined difference in lengths of the waveguides; a first slab waveguide disposed on the substrate and connecting the first channel waveguide with the channel waveguide array; a second slab waveguide disposed on the substrate and connecting an end of the channel waveguide array on the side wherein the first slab waveguide has not been connected thereto with an end thereof; and a second channel waveguide disposed on the substrate and connected to the other end of the second slab waveguide wherein a waveguide part in the connected area has a rectangular field distribution exciting configuration that excites a rectangular field distribution.

Namely, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the respective arrayed waveguide gratings constituting a circular communication system into a rectangular field distribution exciting configuration that excites a rectangular field distribution in the ~~invention~~ invention, as described in ~~claim 9~~ the ninth aspect, wherein the above-described circular communication system is composed of an arrayed waveguide grating having a circular transmission line prepared by connecting circularly a plurality of nodes by the use of transmission lines and transmitting optical signals which have been wavelength division-multiplexed to these transmission lines, and separating the wavelength division-multiplexed optical signals into optical signals having respective wavelengths; and an arrayed waveguide grating for wavelength division-multiplexing optical signals, which have been separated into those having respective wavelengths.

On page 21, revise the paragraph beginning at line 3, as follows:

In the proposal shown in FIG.10, however, there is a limitation that results in the case

where a degree of wavelength division multiplexing is further elevated for the sake of ~~coming~~ allowing a large capacity of information transmission to be possible. The situation will be explained hereinafter. In the arrayed waveguide grating of the proposal shown in FIG.10, each parabolic waveguide part resides on its input side. Accordingly, even though a core opening width D as a tapered width on a side of the channel waveguide array 14 can be individually made in response to a wavelength, core-opening widths W employ one parabolic waveguide part being common with respective wavelengths, so that they must be common. Furthermore, the coefficient α shown in the above expression (1) becomes constant.

On page 21, revise the paragraph beginning at line 16, as follows:

On the other hand, in the case where parabolic waveguide parts 151 (e.g., see FIG. 8) reside individually at positions corresponding to respective wavelengths λ_1 to λ_N as in the present embodiment, a core opening width (optical waveguide width) ~~Wt~~ Wc is common, but a core opening width Wp may be set out in response to the respective wavelengths λ_1 to λ_N. Moreover, a coefficient α can be also set out in response to them. For this reason, a degree of freedom is wider than that shown in the proposal of FIG.10. Thus, delicate adjustment of transmission optical frequency characteristics with respect to an optical frequency f can be performed.

On page 24, revise the paragraph beginning at line 1, as follows:

Therefore, an arrayed waveguide grating broad band operability of which is more elevated than that of the arrayed waveguide grating proposed in FIG.10 can be ~~realized,~~

~~besides such~~ realized. Besides, disadvantages such that a transmission width becomes narrow or that a modulation component is cut off can be eliminated.

On page 24, revise the paragraph beginning at line 7, as follows:

FIG.12 illustrates an essential part of an arrayed waveguide grating wherein an MMI (Multi-Mode Interference) optical waveguide is used as a modified example of the present invention. A section shown in FIG.12 indicates the same range as the waveguide part 152 wherein the outputting channel waveguide 134 is connected to the second sector form slab waveguide 137 in FIG.5. The MMI optical waveguide has a configuration wherein a width of optical waveguide changes step-functionally and discontinuously. Thus, when each waveguide part 201 of the outputting channel waveguide 134 to be connected to the second sector form slab waveguide 137 is made in the form of MMI optical waveguide, disadvantages in the case where the waveguide part has been made ~~tempered~~ tapered can be eliminated as in the above-described case.

On pages 27-31, revise the consecutive paragraphs beginning at line 27 of page 27 through the paragraph ending at line 11 on page 31, as follows:

As described above, according to the inventions as described in ~~claims 1 and 4~~ the aforementioned first and fourth aspects, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the arrayed waveguide grating into a parabolic configuration. In addition, since the parabolic configuration corresponds to the waveguide part of the second channel waveguide connected to the output side of the second slab waveguide in the arrayed

waveguide grating, it is possible that these parabolic configurations have been adjusted in response to corresponding wavelengths, whereby there is such an excellent advantage that the inventions can cope with a trend of broad band in optical signals.

Furthermore, according to the inventions as described in ~~claims 2 and 5~~ the aforementioned second and fifth aspects, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the arrayed waveguide grating into a configuration of a multi-mode interference in which a width of optical waveguide changes step-functionally and discontinuously. In addition, since the configuration as a multi-mode interference corresponds to the waveguide part of the second channel waveguide connected to the output side of the second slab waveguide in the arrayed waveguide grating, it is possible that these configurations as the multi-mode interference have been adjusted in response to corresponding wavelengths, whereby there is such an excellent advantage that the inventions can cope with a trend of broad band in optical signals.

Furthermore, according to the inventions as described in ~~claims 3, 6 and 7~~ the aforementioned third, sixth, and seventh aspects, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the arrayed waveguide grating into a rectangular field distribution exciting configuration that excites a rectangular field distribution. In addition, since the rectangular field distribution exciting configuration that excites the rectangular field distribution corresponds to the waveguide part of the second channel waveguide connected to the output side of the second slab waveguide in the arrayed waveguide grating, it is possible that these rectangular field distribution exciting configurations have been adjusted in response

to corresponding wavelengths, whereby there is such an excellent advantage that the inventions can cope with a trend of broad band in optical signals.

Moreover, according to the invention as described in ~~claim 8~~ the aforementioned eighth aspect, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the respective arrayed waveguide gratings constituting a line-like communication system into a rectangular field distribution exciting configuration that excites a rectangular field distribution wherein the above-described line-like communication system is composed of an optical transmission means for delivering optical signals having respective wavelengths in parallel; a multiplexer composed of arrayed waveguide gratings for subjecting the optical signals having the respective wavelengths delivered from the optical transmission means to wavelength division multiplexing; an optical transmission line for transmitting the optical signals which have been wavelength division-multiplexed and output from the multiplexer; nodes each provided with an arrayed waveguide grating disposed properly in the middle of the optical transmission line; a demultiplexer composed of an arrayed waveguide gratings to which optical signals delivered through the nodes disposed on the optical transmission line are input to separate into each of optical signals having respective wavelengths; and an optical receiver for receiving optical signals having the respective wavelengths separated by the demultiplexer. In addition, since the rectangular field distribution exciting configuration that excites the rectangular field distribution corresponds to the waveguide part of the second channel waveguide connected to the output side of the second slab waveguide in the arrayed waveguide grating, it is possible that these rectangular field distribution exciting configurations have been adjusted in response to corresponding wavelengths, whereby there is such an

excellent advantage that the inventions can cope with a trend of broad band in optical signals.

Besides, according to the invention as described in ~~claim 9~~ the aforementioned ninth aspect, flat optical frequency characteristics are realized by defining a waveguide part of the second channel waveguide connected to an output side of the second slab waveguide in the respective arrayed waveguide gratings constituting a circular communication system into a rectangular field distribution exciting configuration that excites a rectangular field distribution wherein the above-described circular communication system is composed of an arrayed waveguide grating having a circular transmission line prepared by connecting circularly a plurality of nodes by the use of transmission lines and transmitting optical signals which have been wavelength division-multiplexed to these transmission lines, and separating the wavelength division-multiplexed optical signals into optical signals having respective wavelengths; and an arrayed waveguide grating for wavelength division-multiplexing optical signals, which have been separated into those having respective wavelengths. In addition, since the rectangular field distribution exciting configuration that excites the rectangular field distribution corresponds to the waveguide part of the second channel waveguide connected to the output side of the second slab waveguide in the arrayed waveguide grating, it is possible that these rectangular field distribution exciting configurations have been adjusted in response to corresponding wavelengths, whereby there is such an excellent advantage that the inventions can cope with a trend of broad band in optical signals.